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FEASIBILITY STUDY OF COAL GASIFICATION/FUEL
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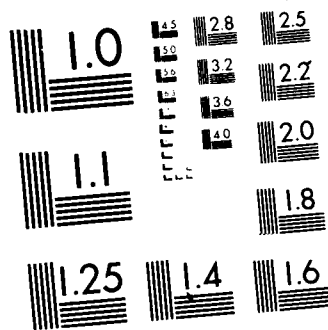
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**FEASIBILITY STUDY OF
COAL GASIFICATION / FUEL CELL / COGENERATION
WASHINGTON D.C. SITE
PRELIMINARY SURVEY**

REPORT CLIN 000201

PREPARED FOR

**DEPARTMENT OF THE ARMY
AND
GEORGETOWN UNIVERSITY**

JUNE, 1966

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Two World Trade Center, 86 10 30 028
New York, N.Y. 10048

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CLIN 000201	2. GOVT ACCESSION NO. AD-A173685	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Preliminary Site Survey For Coal Gas/Fuel Cell/ Cogeneration Project Located at Washington D.C.		5. TYPE OF REPORT & PERIOD COVERED Preliminary Site Survey
7. AUTHOR(s) C Trapp, P Estreich		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS Ebasco Services 2 World Trade Center New York, NY 10048		8. CONTRACT OR GRANT NUMBER(s) DAAG 29-85-C-0007
11. CONTROLLING OFFICE NAME AND ADDRESS Procurement Office Research Triangle Park US Army Research Office N.C. 27709-2211 P O Box 12211		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 611102-BH57-09
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE June 1985
		13. NUMBER OF PAGES 17
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Prepared in cooperation with Georgetown University. The views, opinions and/or findings contained in this report are those of the author(s) and should not be contrued as an official Department of the Army position, policy or decision, unless so designed by other documentation.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Fuel Cell/Coal Gasification/Cogeneration Exemplar Study		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Report discribes site characteristics that could affect the feasibility of a Coal Gas/Fuel Cell/Cogeneration Project as well as discussing existing methods for generating and distributing thermal and electrical energy.		

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PRELIMINARY SITE SURVEY REPORT

1.0 Introduction

→ The purpose of this report is to present the results of the preliminary survey of the Washington D.C. site proposed for a Coal Gasification/Fuel Cell/Cogeneration (GFC) system.

The site characteristics that could affect the feasibility of a GFC installation are discussed as well as existing methods for generating and distributing thermal and electric energy.

2.0 Summary

Section A, (Figure GU 3-1) the portion of the Georgetown University site set aside for coal gasification and gas processing, is compact in nature, but it provides an adequate space for at least one 11 MW module and the future addition of a cooling tower. The elevation of bedrock together with architectural height limitations on the gasifier, due to local ordinances, may impose additional excavation costs on the project. Carefully controlled excavation will be required to protect adjacent buildings including the Heating Cooling Plant and the Observatory.

The basement of the proposed Podium C (Site Section B Figure GU 3-1) appears adequate for three 11 MW modules, each of which includes the fuel cell assembly, power conditioner, and Thermal Management System. An architecturally acceptable means of routing a Heat Recovery Steam Generator exhaust stack from the basement to an elevated point outside the basement must be developed. Stack routing must be direct to avoid placing back pressure on the expander.

Potential emission sources which are primarily in Site Section A should be controllable by system design and operating practices within federal and local environmental limits. For example fugitive dust emissions will be controlled by enclosed material handling equipment, dust suppression sprays and dust collectors; sulfur pit emissions will be controlled by recycling vapor to the oxidizer tanks; the occasional excess gasifier output due to fuel cell demand reduction will be handled by flaring; the noise of coal delivery and handling; rotating equipment can be reduced by enclosures and/or object acoustic treatment of equipment.

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The existing heating-cooling plant is adequate for meeting both current as well as future thermal demand to the year 2000. However, availability of one or more fuel cells would displace a portion of the natural gas used in the standby boilers.

Electrical requirements both present and future to the year 2000 can be supplied by the Potomac Electric Power Company (PEPCO). Expansion in capacity of the existing electric service is indicated by the expansion plans for Georgetown University.

There are no site peculiarities that would affect technical risks identified in the Basic System Description, (CLIN 0001) and none that would eliminate this site from consideration to accommodate a GFC system.

3.0 Site Description

The Georgetown University main campus is one of four sites proposed for the Gasification/Fuel Cell/Cogeneration (GFC) system, is located in Washington DC, four miles northwest of the Capitol, overlooking the Potomac River.

The main campus includes more than 50 buildings totaling 3,300,000 gross square feet which are served by a central heating and cooling plant.

There are no existing buildings available to house part or all of the project components or auxiliary systems for the GFC system.

Within the main campus are two separate locations, termed Section A and Section B, which together comprise the site for the GFC system.

Section A will be used for the gasification and gas processing systems and Section B for the fuel cell, power conditioner and thermal management systems (See figure GU 3-1)

The water required for the gasifiers, the cooling tower make-up, the sulfur removal system and the Thermal Management System makeup will be supplied from the existing 80 to 85 PSIG city water main, located in the existing Heating and Cooling Plant.

Effluent from the GFC plant will be treated to levels that meet the District of Columbia's pretreatment requirements before discharging into the existing 21" sanitary sewer line which feeds into the Blue Plains sewage treatment plant.

3.1 Section A

Section A of the site is bounded by the Heating and Cooling Plant (HCP) on the south, Yates Recreation Center on the north and a 60 foot wide scenic easement to the Glover-Archbold Park on the west.

Within this boundary, the 136 year old "Observatory" building will be retained as a historical landmark.

The existing site in Section A for the first 11 MWe module, includes a sharply sloped hill with its base elevation at approximately 120' near the north wall of the HCP. This hill rises to the Yates Recreation Center parking area at elevation 158'.

This hill will require removal to a distance approximately 150 feet north of the HCP and 250 feet west of the east wall of the HCP.

Three soil borings locate base rock on this site at elevations from 94'-0" to 101'0".

The limit of height for the tallest structure, the gasifier vent stack (approximately 90 feet high) in Section A, is set by elevation 176'-0" which is the roof of the Yates Recreation Center.

The following underground services cross northward through Section A and may require rerouting:

- 12" high pressure steam line
- 6" condensate return line
- 24" chilled water supply line
- 24" chilled water return line
- 6" water line
- 2-4" electrical conduits

3.2 Section B

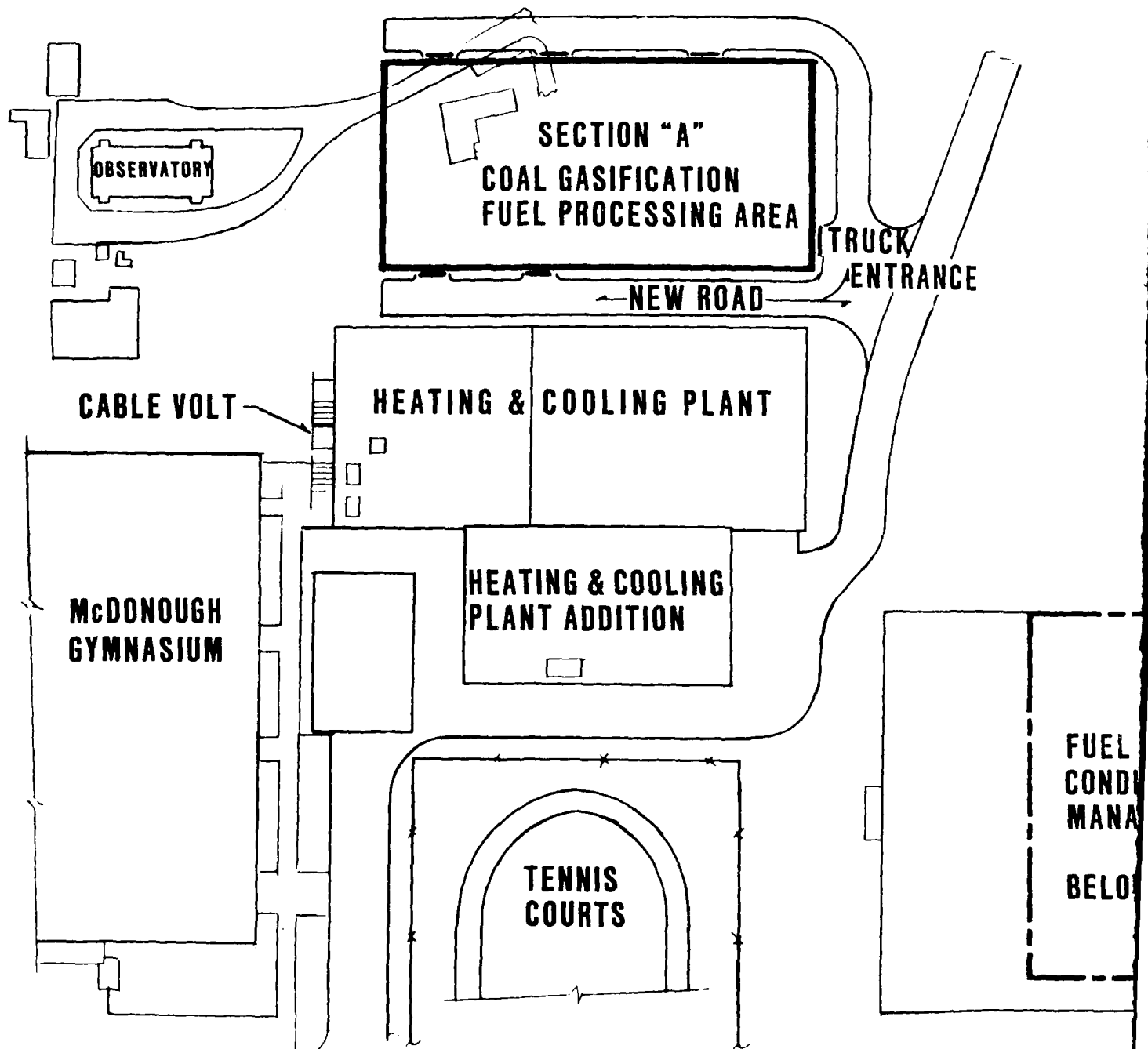
Section B of the site is located in the future Socio-Energy Podium C at basement elevation 58'-0" approximately 160' south and 110' east of Section A. A future transportation center and parking facilities will be located at levels above Section B.

The overall size of Section B including the approach ramp is approximately 445 ft (east-west) by 314 ft (north-south) with headroom ranging between 29 feet to 34 feet.

Predominant column spacing in this area is 62'-0" (north-south) and 30'-0" (east-west) and should not seriously impede layout of the equipment.

Vehicle access is from a ramp on the east boundary of Section B.

TO YATES RECREATION CENTER ↗



SECTION "B"
FUEL CELL POWER
CONDITIONER & THERMAL
MANAGEMENT SYSTEM
AREA
BELOW SOCCER FIELD

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COAL GAS / FUEL CELL / COGENERATION

PLOT PLAN

FIGURE GU 3-1

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4.0 Site Peculiarities

1. Compactness of this site places it in close proximity to other university buildings and to heavily trafficked areas of the campus.

Consequently complete control of dust, emissions, odors and noise is essential.

The coal gasification and gas processing plant has several emission points including the:

- Gasifier
- Cyclone dust and gasifier ash removal system
- Ammonia Stripper
- Stretford oxidizer vent
- Sulfur pit

Gasifier emissions may occur as gas leaks around pokeholes during the poking operation. The emissions can be minimized by decreasing the air flow to the gasifier during the poking operation, placing the gasifier under a slight negative pressure. Additionally, careful maintenance of the pokehole covers might reduce the emissions.

Another source of gasifier emissions is the off spec gas produced during start-up or unexpected upsets. The gases will be flared resulting in small intermittent emissions of NO_x and SO_2 .

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Fugitive emissions from the gasification system consisting of coal dust and gases leaking from the coal handling system or the pokeholes, will be removed and controlled by the ventilation system of the gasification enclosure. The vent stream can be either recycled to the process or flared for the complete destruction of the pollutants. Fugitive emissions from the removal of cyclone dust and gasifier ash are considered to be too small to require control methods.

The ammonia released during stripping of the process condensate will be flared continuously, producing some minor amounts of NO_x .

The Stretford oxidizer vent which is released to the atmosphere consists mainly of air carrying water vapor picked up from the solution. Potentially, very small amounts of ammonia and hydrocarbons could be present in the vent stream. The extremely low concentration of ammonia in the anode feed gas (0.5 ppm) and the low solubility of hydrocarbons in water, lead to the conclusion that the possibility of the presence of those products in the Stretford oxidizer vent is very remote.

The sulfur pit emissions consist of sulfur vapors. A ventilation system of the sulfur pit will remove the vapors and recycle them to the Stretford oxidizer tanks.

It is expected that the emissions discussed in this section will cause no operational problems and can be controlled well within the environmental limits for the area.

Noise from rotating apparatus or coal handling equipment will be contained by suitable enclosures.

2. The GFC plant site is divided into Sections A and B, requiring additional investment in connecting services - i.e., power, steam and condensate return. Also, additional operating personnel may be required as a result of this separation and to operate the Heat recovery Steam generator in Section B of the site.
3. An architectural height limitation of 90' may require additional excavation to conform to this requirement. The relatively shallow location of rock may result in high excavation costs.

Rock removal operations must be carefully controlled to protect structures and foundations of adjacent buildings as well as equipment in the Heating and Cooling Plant. (Refer to Figure GU 3-1)

5.0 Existing Thermal Energy Sources and Distribution

The thermal load of the main campus is supplied by the Central Heating and Cooling Plant. This plant includes three boilers each with a steam generating capacity of 100,000 lb/hr. Two boilers are capable of firing oil or gas and the third can fire coal.

The coal boiler is of the fluidized bed type which feeds 625 psig saturated steam to a 2-stage back pressure turbine generator rated at 2270 kW. Steam exhausts from the first stage to a 275 psig header which is also fed by the supply mains of the two gas/oil fired standby boilers.

The 275 psig header supplies steam to the turbine drives for two centrifugal refrigeration compressors, nominally rated at 3000 tons, to power plant auxiliary equipment and to a pressure reducing station discharging at 90-125 psig to the campus heat distribution system.

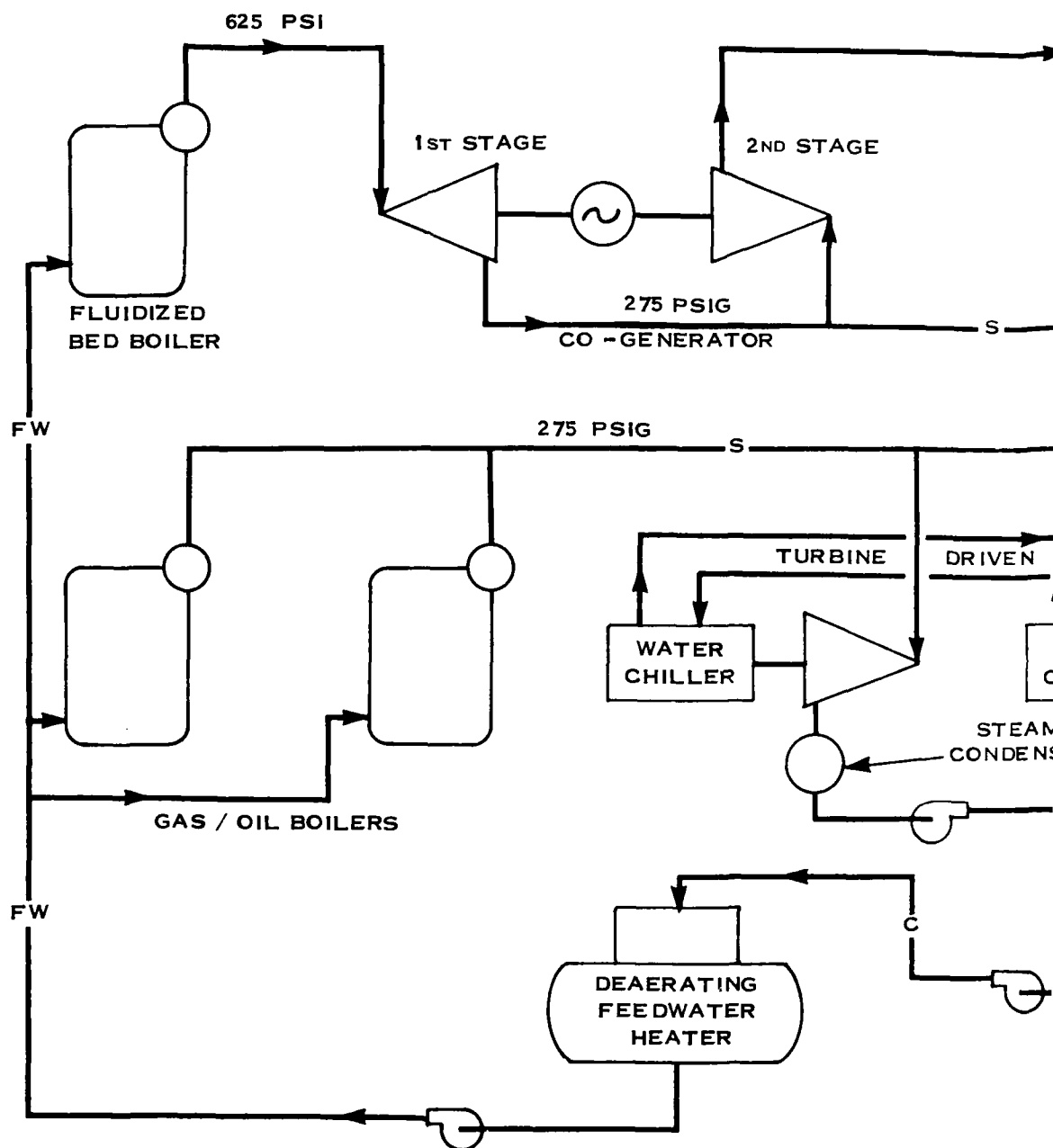
Steam at 90 to 125 psig from the second stage of the cogenerating turbine supplies the campus heating system. (See Figure GU 5-1).

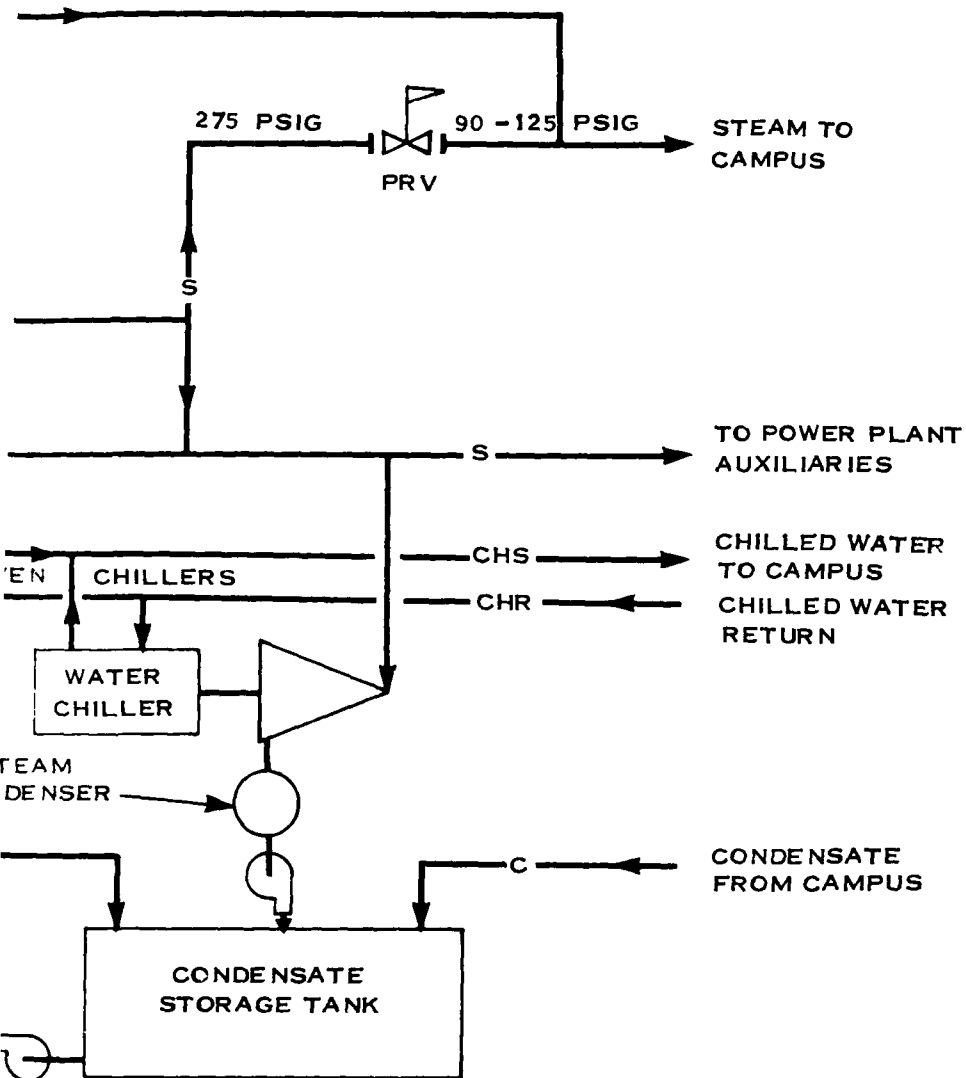
The underground heat distribution for the main campus is supplied from two sets of insulated steam and condensate return mains. The first set of steam and condensate return mains is 12" and 6" respectively, and supplies most of the main campus that is north of the HCP.

The second set of mains - 5" steam and 2-1/2" condensate return - feeds the remainder of the campus.

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The pressure of steam serving each campus building is reduced at its respective valve station to levels suitable for space heating and air conditioning, domestic hot water heating and where applicable for hospital equipment and kitchen equipment.





SYMBOLS:

S - STEAM
 C - CONDENSATE
 FW - FEEDWATER
 CHS - CHILLED WATER SUPPLY
 CHR - CHILLED WATER

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THERMAL SYSTEM DIAGRAM

FIGURE GU 5-1

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6.0 Existing Electrical Energy Sources and Distribution

The electrical requirements for the main campus are purchased by Georgetown University from the Potomac Electric Power Company (PEPCO). The north and south sections of the main campus are each supplied with electricity through three metered main feeders.

The north campus has a system capacity of approximately 7,000 KW and the south campus has a system capacity of approximately 6,500 KW at 13.2 KV. (Total campus capacity is approximately 13,500 KW). The current total campus annual peak demand is approximately 12,600 KW which occurred in September of 1984. The monthly electrical load during the remaining part of the year varies from a low of about 10,000 KW to a high of 12,300 KW.

In addition to the purchase of electricity, as outlined above, the University has capability to generate its own electricity from internal sources. The first source is a solar energy photovoltaic power system capable of producing 300 KW and has been in operation since late summer of 1984. The second source is a 2,270 KW steam turbine driven cogenerator which has just been installed and is currently undergoing testing. Both of these sources are connected to the campus electrical system with the necessary metering required by PEPCO, the local utility.

7.0 Fuel Supply

Two sources of coal are being considered for the GFC system at Georgetown University.

The first source is from the Unionvale Corp which would supply an Eastern Kentucky stoker coal with a maximum Fuel Swell Index (FSI) of 4. The coal would be loaded on a barge on the Big Sandy River at Kenova, West Virginia and barge to Monaca, Pennsylvania where it would be unloaded, stock piled and then trucked to Georgetown. The study will be based on the use of this coal due to the fact they are the current suppliers of coal to Georgetown University for the AFB.

The second source is ANR which would supply a Pilse County, Kentucky coal with an FSI that is 4.5 or less. The coal would be transported from the mine directly to Georgetown University by truck via existing roads.

Natural gas which will be used as an alternate fuel for the GFC system is currently available on the Georgetown University Site.

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